labeled. Submitted herewith are copies of the three sheets of drawings submitted with the application as filed, now marked in red to indicate changes that applicants propose to make to overcome the objection. It is respectfully requested, however, that the requirement to formally make the changes be held in abeyance until such time that this application has been allowed. The same is true for the other required corrections, as indicated on PTO Form 948.

Applicants are submitting herewith a Substitute Specification showing additions (underlined) and deletions [in brackets]. Applicants also attach hereto a clean copy of the new, amended specification, with no underlinings or brackets.

The single claim has been rejected as being obvious and, therefore, unpatentable over the primary patent to Gasworth in view of or when combined with the secondary patent to Muka et al., for reasons set forth in paragraph 2, bridging pages 2-4 of the Official Action. Essentially, the Examiner has taken the position that Gasworth meets all of the limitations recited in original claim 1 "less the directivity of the plasma jet from 'bottom upwards.'" The Examiner has also recognized that Gasworth fails to teach a window and a movable shutter through which a manipulator can move wafers. The Examiner relies on Muka et al. for the latter teaching.

For reasons that are more fully set forth below, applicants respectfully traverse the rejection based upon the applied references and request that such rejection be reconsidered and withdrawn.

The present invention is for a device for treating wafers with a plasma jet. It has a very specific application which, in certain respects, dictates some of the physical and structural aspects

of the claimed invention. The applied references not only fail to teach the invention as defined in the original claim and in the claims submitted herewith, but even fail to teach the general problem which the present invention has solved. Thus, the primary patent to Gasworth is for an apparatus for producing diamonds by chemical vapor deposition and articles produced therefrom. That technology is quite remote from that used for treating wafers with a plasma jet. While the secondary patent to Muka et al. may teach the use of a movable shutter through which a manipulator may be passed, Muka et al. in fact adds little, if anything, to the more prominent features of the present invention.

In order to more particularly point out and distinct claim applicants' invention, claim 1 has been canceled and new claims 2-13 have been added. Claim 2 is primarily directed to that structural feature of the present invention in which the plasma jet generator is situated or arranged beneath the wafer holders and mounted on a base on a support which allows desired heat treatment temperatures to be developed. The directivity of the plasma jet from the bottom upwardly allows improved temperature control within the chamber by employing the natural convection of hot gases. Because the heated gases rise and the plasma jet is arrange below while the jet is directly upwardly, this arrangement is important as it avoids the need for additional cooling of the plasma jet generator and prevents the same from overheating from hot gases to which it would otherwise be exposed if it were arranged in a reverse direction. It is clear from Gasworth that this patent contains no teaching whatsoever, nor any suggestion, of such an arrangement. In fact, in Fig. 1 of the primary reference, the plasma jet or torch has its cathode 14

arranged at the top of the device and the energy is directed downwardly, in a direction opposite to the teachings of the present invention as now more clearly defined in claim 2.

New independent claim 7 addresses a construction in which wafer holders include at least three vortex chambers with axes generally perpendicular to the horizontal platforms of the holder. Each vortex chamber is in fluid flow communication with the gas supplying means. It should be clear that with such a construction, in which the gas flows through the vortex chamber help to remove heat from the regions of the wafers, that this makes it possible to achieve a stable, non-contact-supporting system for wafers adjacent to the holders with a relatively small gas gap. Such arrangements of the vortex chambers provide cooling of given sites on the wafers equalizing wafer heating energy at all given sites on the wafer. This results in improved quality of the treated wafers. Again, there is no teaching or even remote suggestion of such construction in either one of the primary or secondary references.

New independent claim 10 addresses the use of limiters provided at the edges of the wafer holders, with such limiters having lengths and being arranged to limit the maximum positional deviations of the treated wafers during treatments thereof. The use of such rod-like limiters on the holders assures centering of the loading wafers. Again, the applied references fail to teach or even remotely suggest such construction, as their application is entirely different from that of the present applications.

The remaining claims of record, which now depend, directly or indirectly, on presumably allowable claims 2, 7 and 10, should, therefore, be allowed with the allowance of these three

independent claims.

That the prior art references would not suggest and/or render the presently claimed invention is further evident from the classifications in which the primary and secondary references have been classified. The primary patent to Gasworth is in class 427, which covers coating processes, while the secondary reference has been classified in class 414, which covers material or article handling. As these have been classified in different classes, it is believed to be further indicative of the fact that it would not necessarily be obvious for one skilled in the art to go to those two classes to select references from these classes in order to try to combine these references in a manner which has been proposed by the Examiner. This is believed to be particularly true since these references do not teach or even remote suggest applicants' invention, nor would applicants' invention result even if such proposed combinations were to be made. Under the circumstances, it is not believed that one skilled in the art would combine the references as has been proposed by the Examiner, and such proposed combination could only be made with the hindsight of the present application and the teachings contained therein.

Obviousness cannot be established by combining the teachings of prior art references to produce the claimed invention, absent some teaching, suggestion or incentive supporting the combination. Carella v. Starlight Archery, 804 F.2d 135, 231 USPQ 644 (Fed. Cir. 1986). More recently, the Court of Appeals of the Federal Circuit has held that the U.S. Patent and Trademark Office erred in rejecting the claimed invention as an obvious combination of the teachings of two prior art references where the prior art provided no teaching, suggestion or incentive supporting

the combination. In re Bond, 910 F.2d 831, 15 USPQ 2d 1566 (Fed. Cir. 1990. See also In Symbol Technologies, Inc. v. Opticon, Inc., 935 F.2d 1569, 19 USPQ 2d 1241 (Fed. Cir. 1991). The Court of Appeals of the Federal Circuit stated:

> We do not "pick and choose among individual elements of assorted prior art references to recreate the claimed invention," but rather we look for "some teaching or suggestion in the references to support their use in the particular claimed combination."

See also In re Bell, 991 F. 2d 781, 26 USPQ 2d 1529 (Fed. Cir. 1993) and In re Lowry, 32 F. 3d 1579, 32 USPQ 2d 1031 (Fed. Cir. 1994). The Court of Appeals of the Federal Circuit has consistently followed this rule. In a very recent decision, this principle was reaffirmed in Sensonics, Inc. v. Aerosonic Corp., 81 F. 3d 1566, 38 USPQ 2d 1551 (Fed. Cir. 1996), where the Court observed that there was no teaching or suggestion in the prior art refereances which would cause a person of ordinary skill to have been led "to select various mechanical and electrical structures and concepts and combine them as did the inventor." It is respectfully submitted that the same is true in this case. The combination proposed by the Examiner is clearly based upon a hindsight approach, using the present application and the teachings contained therein as a road map for picking and choosing isolated elements from prior art references. For the aforementioned reasons, it is believed that it would not be obvious to combine the references as proposed by the Examiner.

In view of the foregoing, it is respectfully requested that the rejection in the Office Action be reconsidered and withdrawn.

U.S. Patent Application of Tokmulin et al.
Serial No.: 08/860,763
Art Unit: 1763

This application is now believed in condition for allowance. Early allowance and issuance is, accordingly, respectfully solicited.

Dated: February 2, 2000

Respectfully submitted,

LACKENBACH SIEGEL MARZULLO
ARONSON & GREENSPAN, P.C.
Lackenbach Siegel Building
One Chase Road
Scarsdale, NY 10583
(914) 723-4300

LACKENBACH SIEGEL MARZULLO
ARONSON & GREENSPAN, P.C.
Attorneys for Applicant(s)

By: _____
MYRON GREENSPAN
Reg. No.: 25,680

MG/as

MAILING CERTIFICATE

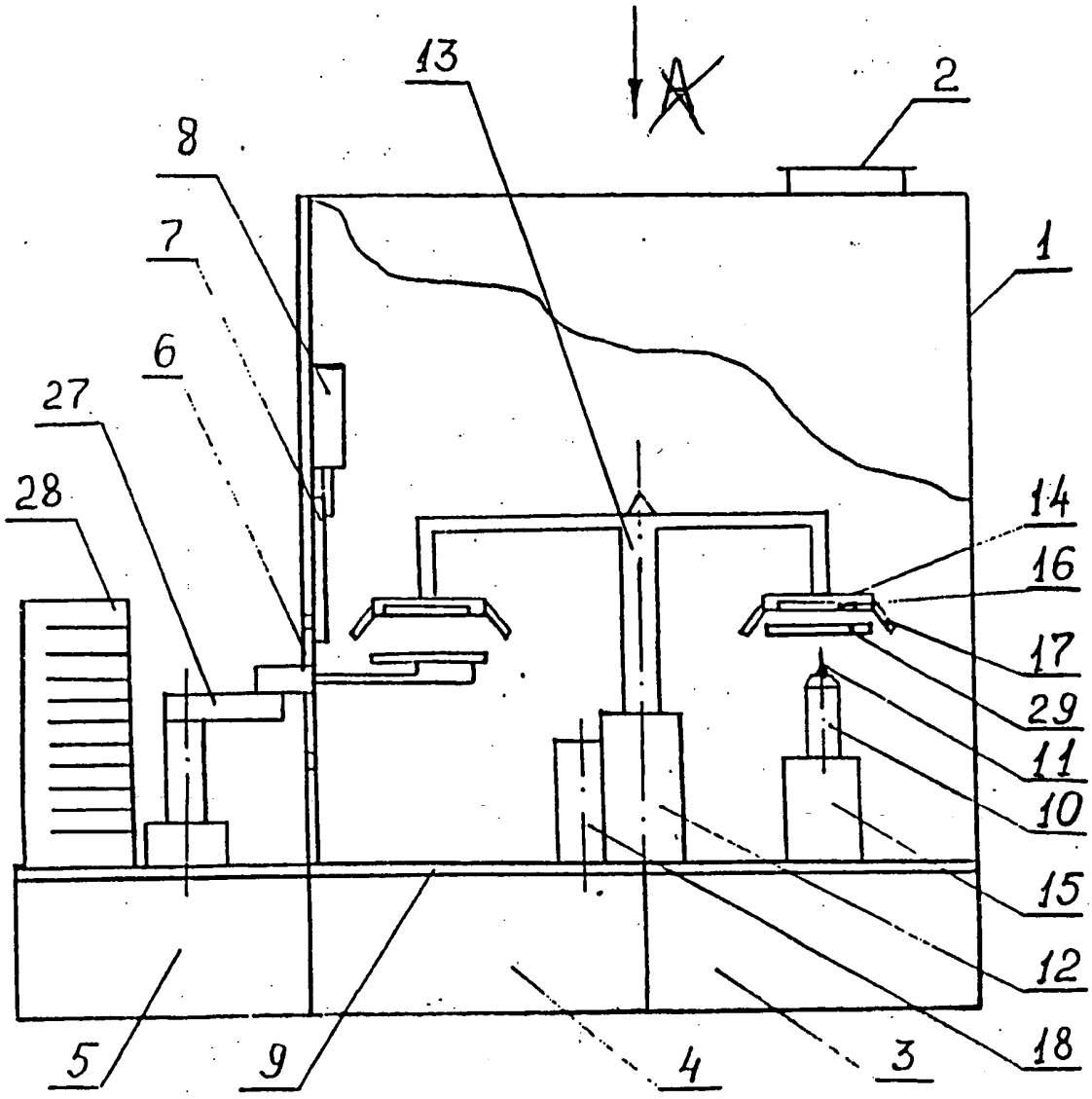
I hereby certify that this correspondence is being deposited with the United States Postal Services as first-class mail in an envelope addressed to: Commissioner of Patents and Trademarks, Washington, D.C. 20231, on the date indicated below:

Myron Greenspan
Attorney's Name

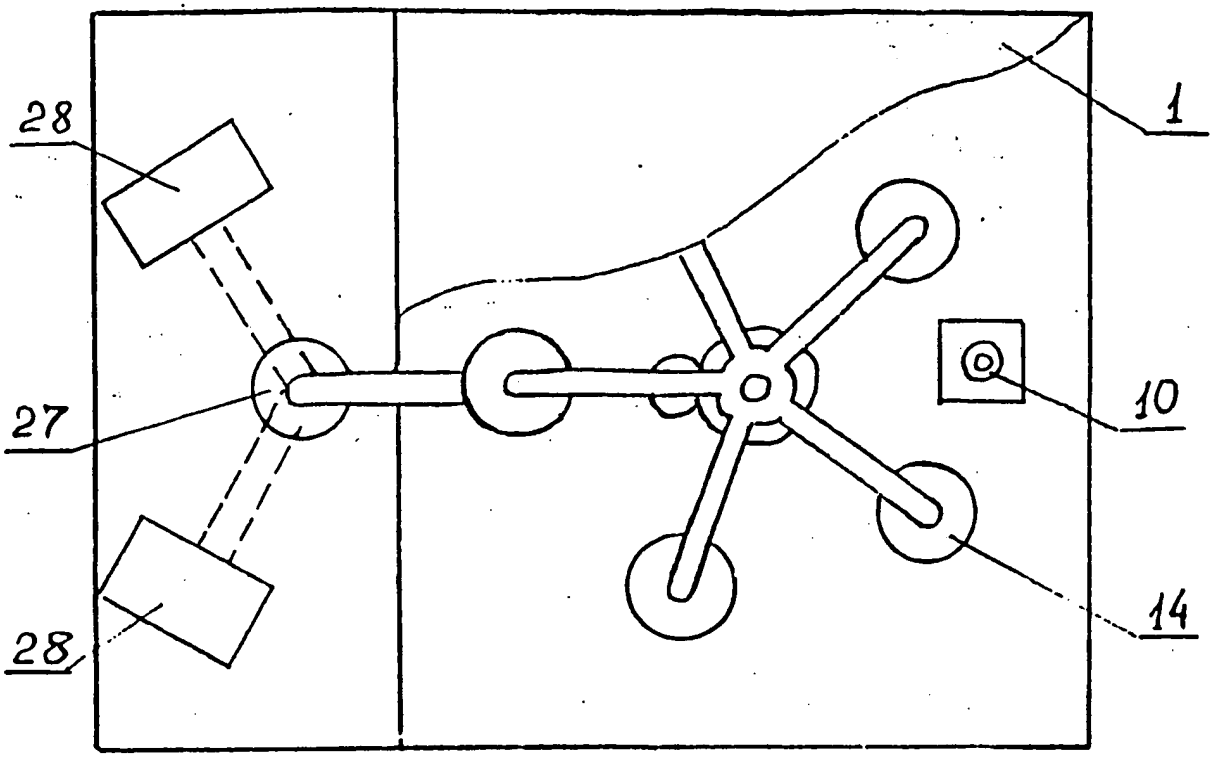
_____
Signature

February 2, 2000
Date

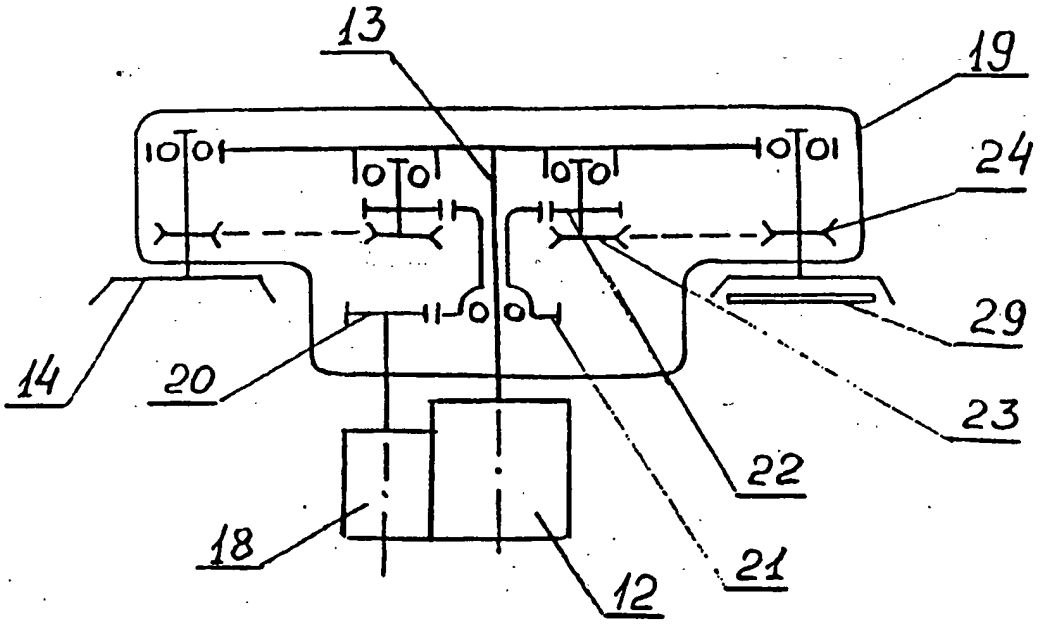
Applicant hereby petitions that any and all extensions of time of the term necessary to render this response timely be granted. Costs for such extension(s) and/or any other fee due with this paper that are not fully covered by an enclosed check may be charged to Deposit Account #10-0100.



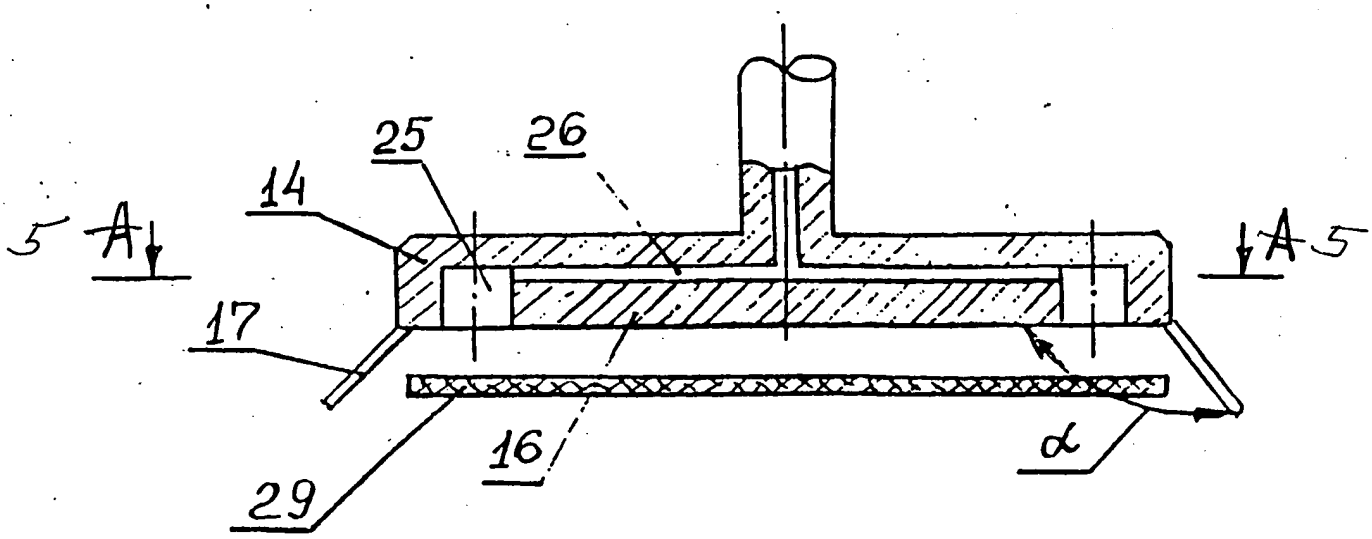
Фиг. 1 FIG. 1



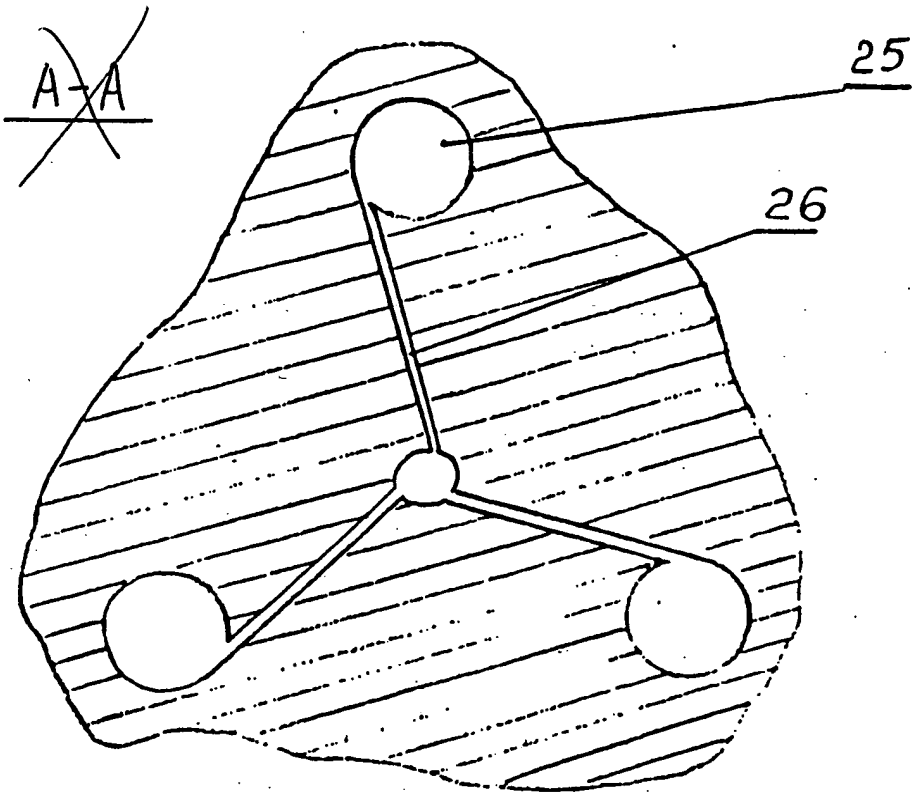
~~Фиг. 2~~ FIG. 2



~~Фиг. 3~~ FIG. 3



~~Фиг. 4~~ FIG. 4



~~Фиг. 5~~ FIG. 5

DEVICE FOR TREATING [WAFERS] PLANAR ELEMENTS WITH A PLASMA JET (SUBSTITUTE SPECIFICATION, with amendments marked)

BACKGROUND OF THE INVENTION

Field of the Invention.

The present invention relates to the field of plasma technology and may be used in electronics and electrical engineering when treating planar elements, for example, semiconductor wafers, substrates, printed circuit boards, compact disks and other products.

Description of the Related Art.

There has long been known a device for studying a [plasma - surface] plasma-surface interaction, a device that comprises [comprising] a plasma generator, a power source therefor, a system for the plasma generator displacement, a system for displacing samples, a gas distribution system and a control system (see, [Theses of the Reports at the 10th All-Union Conference] Theses of the Reports at the 10th All-Union Conference, P.P. Kulik et al., "Low-Temperature Plasma Generators," Part II, Minsk, ITMS Publishers, Academy of Sciences of Byelorussian Soviet Socialist Republic, 1986, p. 135 [, Kulik P. P. et al.]). However, this [This] device has a number of disadvantages.

The absence of a quick-operating loading-unloading system results in [high time expenditures] a large expenditure of time and, hence, plasma generator energy [consumable] that is consumed to no purpose when [replacing] plates-samples to be treated are replaced. The [lack of the possibility] inability to simultaneously treat several plates-samples [,] one right after another [,] decreases the output of the device.

[The presence] The fact that there are present in [the] this device [of] a [plurality] number

of control and measuring means [which are inhibitory to] that inhibit [the performance of a] any repeated treatment of samples according to a rigidly prescribed cycle, unambiguously defines this device as [being a purely research one] one purely for research.

Taken together, [all] the above-mentioned features result [results] in the fact that the device cannot be used under conditions of [the] series production [conditions].

The closest prior art has been described in [the] International [application] Application No. WO 92/21220, H05H 1/40, 1992, [disclosing] which discloses a device for treating wafers with a plasma jet, comprising a plasma jet generator; gas supplying means; a set of holders for wafers to be treated [;] _, said holders being structurally made in the form of a turntable having a drive for effecting angular displacement thereof and for facing a generator plasma jet turned downwards; each of the holders being made in the form of a horizontal platform [to rotate] mounted for rotation about the axis passing through the center thereof and being perpendicular to the plane of said platform; and said plasma jet and wafer holder having the possibility [to be] of being displaced with respect to each other in the direction of at least one axis of coordinates and may be in or out of contact with each other.

The main [Main] drawbacks associated with this device [reside in] include an underproductivity [limited] created by [a] the large [volume] number of manual operations necessary when loading-unloading the wafers to be treated. In [so doing] addition, the wafers treated are inferior in quality due to [a possible] the possibility of surface damage [of their surface] when contact-attaching in the holder.

Moreover, the direction of the plasma jet from top to bottom necessitates taking the measure [-taking on the provision] of the cooling of the plasma generator from overheating

caused by upwardly moving [with upward-coming] hot gases formed during operation of the plasma generator.

SUMMARY OF THE INVENTION

The application according [According] to the present invention [, there is provided] provides a device for treating wafers with a plasma jet, comprising a plasma jet generator, gas supplying means [,] and a set of holders for wafers to be treated. The holders have a drive for effecting angular displacement [thereof] of the wafers and face a generator plasma jet _. _ [, each] Each of the holders [being] is made in the form of a horizontal platform to rotate about the axis passing through the geometric center thereof and perpendicular to a plane of said platform. Said plasma jet and wafer holder [have the possibility to] can be displaced with respect to each other in the direction of at least one axis of coordinates _, _ and they may be in or out of contact with each other. The device further comprises a manipulator, storage devices for the wafers to be treated, and a closed chamber having a gas exchange system with the wafer holders and a plasma jet generator located inside said chamber [such] in such a way that a plasma jet is directed from bottom upwards in respect of a plane of locating horizontal platforms of said wafer holders. The closed chamber is provided with a window in which a movable shutter is installed. The manipulator is located [to contact with] in such a way that it contacts said storage devices directly and with said wafer holder indirectly, through the chamber window. Each of the wafer holders is provided with a limiter at the edges and has its horizontal platform provided with at least three vortex chambers and three tangential channels perpendicular to a plane of said horizontal platform [, wherein each of said] Each of these vortex chambers is provided with an open portion located

on a level end surface of the wafer holder, coupled through a tangential channel to [said] the gas supplying means and located in such a way that the vortex flows that are formed [afford holding] make possible the positioning of the platform near the holder and the cooling of its individual areas to equalize, over the wafer surface, [an] the amount of energy used for [treating] treatment thereof. [Said] The limiters on the wafer holder platforms are fabricated [as] so that the rods are mounted at an angle $\alpha > 90°$ to the plane of said horizontal platform of the wafer holder. In so doing, their length, l, is chosen such that

$$21 \sin (\alpha > 90°) > \Delta,$$

where Δ denotes a maximum deviation from axisymmetric arrangement of the treated wafers in said storage devices.

[The technical result of using the proposed device is attained by the following features in accordance with the present invention.]

The proposed device in accordance with the present invention achieves its technical results because it contains the following features:

(1) It provides [Provision of] the device with a common rotary drive for the holders, [said drive being] with this drive mounted inside the closed chamber and having its actuating mechanism connected to each of the holders . [,] This drive greatly enhances the output of the device.

(2) It introduces [Introduction of] a manipulator , with storage devices for the wafers , to be treated, which makes it possible to further enhance the treatment capacity [at the expense of] while reducing [a] the time [need] needed for loading-unloading the wafers.

(3) It further introduces [The use of] a wafer holder [having] with at least three vortex

chambers and three tangential channels with the axes of said vortex chambers perpendicular to the horizontal platform of the holder, where each of said vortex chambers being coupled to the tangential channel connected to the gas supplying means __ [, allows achievement of a stable holding] This permits the stable positioning of the wafer to be treated in the vicinity of the holder with a gas gap without touching the wafer and the holder __ which, in turn, [enables] makes it possible to upgrade [the] treatment quality due to the absence of the touch traces (scratches).

(4) It arranges [Arrangement of] each of the vortex chambers in the holder such that vortex flows formed by said vortex chambers [enable] make possible the fulfillment, at each side of the wafer surface, of the condition [for]

$$Q_0 = Q_1 + Q_2,$$

where:

Q_0 = [const] a constant – an amount of energy for heating the wafer in the given site;

Q_1 – an amount of energy received by the given site of the wafer surface with due regard to thermal transparency thereof;

Q_2 – an amount of energy available at the expense of interaction with a material of the wafer surface in the given site __ [,]

This makes it possible to produce more uniform, and hence, [high-] higher- quality treatment of the wafer. [This is conditioned by] This result is based on fact that each vortex chamber, when creating a gas vortex, [makes it possible not only to hold] permits not only the positioning of the wafer near the holder but also [to cool] the cooling of individual areas of the wafer to be treated. Since in the process for treatment, different sites on the surface of the wafer to be treated are originally under different thermal conditions, then [proceeding from an] the energy balance caused

by these vortex flows [enable] make possible the establishment of [the] conditions [to] that equalize Q_0 at all sites of the wafer.

(4) It uses [The use of] limiters on the holders in the rods mounted at an angle $\alpha > 90°$ to the horizontal platform of the holder, with their length l [,] being chosen such that

$$21 \sin (\alpha > 90°) > \Delta,$$

where Δ denotes a maximum deviation from axisymmetric arrangement of the wafers in said storage devices, [offers a required accuracy] creates the possibility of the accuracy needed when loading-unloading the wafers, without using additional centering means.

BRIEF DESCRIPTION OF THE DRAWINGS

Other objects and advantages of the invention will [be] become apparent from the following description , when taken in connection with the accompanying drawings, in which:

FIG. 1 is a view showing a device for treating wafers with a plasma jet;

FIG. 2 is a "breakaway" top plan view [A] of FIG. 1;

FIG. 3 is a functional diagram of an actuating mechanism of a common rotary drive for holders;

FIG. 4 is a view showing a wafer holder; and

FIG. 5 is a sectional view [A-A] along line 5-5 of FIG. 4.

[BEST MODE TO CARRY OUT THE INVENTION]

DESCRIPTION OF A PREFERRED EMBODIMENT

[Referring to] FIGS. 1, 2 [, there is illustrated] illustrate a device for treating wafers with a

plasma jet, comprising a closed chamber 1; a gas exchange system 2; a power supply unit 3; gas supplying means 4; and a control system 5. The closed chamber 1 is provided with a window 6 in which a movable shutter 7 with a drive 8 is installed. Inside the closed chamber 1, on a base 9, [there are located] a generator 10 of a plasma jet 11 [,] and an angular displacement drive 12 with its upright shaft 13 coupled to holders 14 are located. The generator 10 of the plasma jet 11 facing the holders 14 is mounted on the base 9 on a support 15 adjustable for height such that the axis of the plasma jet 11 and respective axes of each of the holders 14 are equidistant from the axis of the upright shaft 13 of the angular displacement drive 12. Referring to FIG. 4, the holders 14 are made in the form of horizontal platforms 16 with limiters 17. Said limiters 17 are fabricated as the rods, for example, cylindrical rods. With reference to FIG. 3, [it is seen that the] horizontal platforms 16 are set in rotation about their axes by a drive 18, for example, by means of an actuating mechanism 19 through a step-by-step interaction of its gears 20, 21, 22 and pulleys 23, 24. [It is illustrated in] In FIGS. 4 and 5 [that] the horizontal platforms 16 are provided with vortex chambers 25 each having an open portion located on a level end surface of the holder 14 and coupled to a tangential channel 26 connected to said gas supplying means 4. [It is shown in] In FIG.1 [that] outside the closed chamber 1, on the base 9, a manipulator 27 and storage devices 28 for wafers 29 are mounted.

[INDUSTRIAL APPLICABILITY]

The device operates as follows.

In the initial state, one of the storage devices 28 is provided with wafers 29, while the other is free from the wafers. [A] The manipulator 27 [serves to grip] grips a bottom wafer 29 in

the storage device 28 and [to transport] transports it through a window 6 (with a shutter 7 opened by a drive 8) [inwards] into the [a] closed chamber 1. At [that] this moment, [a] the first of the holders 14 is [under loading] being loaded. The manipulator 27 conveys the wafer 29 [in] into a position below [a] the horizontal platform 16 of the first holder 14.

By switching on the gas supplying means 4 in the vortex [chambers 25, 26] chamber 25 and the channel 26, of the holder 14, gas vortex flows are generated [to provide for the holding of] for the positioning / maintaining of the wafer 29 at a distance of about 0.5 - 1.0 mm from [a] the level end surface of the platform 16 of the holder 14. At that moment, the manipulator 14 releases the wafer 29. The wafer [has been] is now loaded. Thereupon, the next wafer is loaded.

In [an] the embodiment [as] illustrated here, a device for treating wafers with a plasma jet is provided with five wafer holders [located at] angularly displaced at an angle of 72° to one another in the horizontal plane. Feeding the next holder in the loading zone is performed with an angular displacement drive 12 for the holder 14.

[On loading of] Once all the holders are loaded, the manipulator 27 is withdrawn from the closed chamber 1 while closing the shutter 7 with the drive 8. [A] The required gas is then supplied to the chamber. By means of [a] the support 15, [a] the generator 10 of [a] the plasma jet 11 is mounted, with respect to the surface of the wafer 29 to be treated, at a height suitable for [a manufacturing process] manufacture. On switching the drive 18, the holders 14 start [rotation,] to rotate about their axes, together with the wafers 29 [, about their axes]. [In so doing, a] Simultaneously, the control system 5 is used to [specify] regulate the dynamics of the wafer movement. The generator 10 of the plasma jet 11 and the angular displacement drive 12 are switched and [the] treatment is [carried out] performed.

[Following] After a prescribed number of contacts of the wafer 29 with the plasma jet 11 of the generator 10, the drive 12 is brought to a [stop] halt, under the predetermined program from the control system 5, [such] so that none of the wafers 29 in the holders 14 falls within the zone of action of the generator plasma jet. The [Then, the] drive 18 and the generator 10 are then turned off.

[Hereinafter, the] The cycle may then be [is] repeated [using] with the next batch of wafers.

Various modifications may be made to this device and to this embodiment without departing from the spirit or scope of the general inventive concept as defined by the appended claims.